

Attorney Docket No. 980615CD/LH

**IN THE UNITED STATES PATENT  
AND TRADEMARK OFFICE**

Applicant(s): Hiroyuki OKAHIRA et al

Serial No. : To be assigned (Division  
of USSN 09/158,362, filed  
September 22, 1998

Filed : Concurrently herewith

For : APPARATUS FOR INSPECTING  
A SUBSTRATE

Prior  
Art Unit : 2877

Prior  
Examiner : T. Nguyen

**PRELIMINARY AMENDMENT  
AND INFORMATION DISCLOSURE STATEMENT**

Assistant Commissioner for Patents  
Washington, D.C. 20231

S I R :

Please amend the above-identified application as follows:

**IN THE ABSTRACT:**

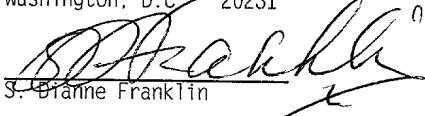
Replace the Abstract on page 57 of the present application  
with the new Abstract attached hereto on a separate sheet.

**IN THE SPECIFICATION:**

Page 1, between lines 4 and 5, insert the following  
paragraph:

This is a Division of Application Serial No. 09/158,362  
filed September 22, 1998.

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S. Dianne Franklin

In the event that this Paper is late filed,  
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required in connection with this Paper  
to Account No. 06-1378.

Replace the paragraph on page 1, lines 8-18, as follows:

Of conventionally-known apparatuses for inspecting defects of LCD glass substrates, some apparatuses are known in which defects (e.g., scratches) formed in the surface of the glass substrate can be checked by using a macro observation and a micro observation interchangeably. In the macro observation, light is applied onto the surface of the glass substrate and then optical change of the reflected glass is observed, thereby detecting the defects. In the micro observation, the defects found by the macro observation are magnified and observed.

Replace the paragraph on page 1, line 19 through page 2, line 1, as follows:

For example, Jpn. Pat. Appln. KOKAI No. 5-322783 employs the macro observation system and the micro observation system which are set so as to correspond to an X-Y stage designed movable horizontally in X and Y directions. In the apparatus, the macro observation or the micro observation is performed by mounting a substrate on the X-Y stage and bringing a portion of the substrate to be inspected (defect) into an observation field of the macro

observation system or the micro observation system by moving the X-Y stage two-dimensionally in the X and Y directions.

Replace the paragraph on page 2, lines 2-11, as follows:

Recently, the size of the glass substrate has tended to be increased with an enlargement of LCDs. In the case where such a large glass substrate is inspected by using the inspecting apparatus having the X-Y stage which is movable horizontally and two-dimensionally (X, Y directions), an area four times as large as the area of the glass substrate is required as a space for moving the X-Y stage. Therefore, the substrate inspecting apparatus has inevitably become large with the increase in size of the glass substrate.

Replace the paragraph on page 2, lines 12-19, as follows:

Furthermore, in the conventional inspection apparatus, it is difficult to inspect a small scratch since the surface of the substrate is far away from an eye position of the inspector. Moreover, it is difficult to obtain positional data of the defect found in the surface of the substrate. Accordingly, it is been impossible to inspect the substrate highly accurately.

Replace the paragraph on page 12, line 12 through page 13,  
line 9, as follows:

FIG. 6 shows how to inspect a substrate by use of the inspecting apparatus of the present invention. As shown in FIG. 6, an entire-area illuminating macro light source 30 is set above the main apparatus 1. The macro light source irradiates the entire area of the surface of the substrate 3 on the holder 2. The macro light source 30 comprises a metal halide lamp 31 serving as a point light source, a reflecting mirror 32 arranged so as to face the metal halide lamp 31, and a fresnel lens 33 arranged below the reflecting mirror 32. The reflecting mirror 32 is tilted at an angle of 45° with the main apparatus 1 and plays a role in reflecting light incident from the metal halide lamp 31 and injected into the fresnel lens 33. The fresnel lens 33 converges the light reflected by the reflecting mirror 32, as shown in the figure, and injects the converged light over the entire surface of the substrate 3 on the holder 2. Note that, as shown in FIG. 1, the main apparatus 1 has a Y-scale 13 for detecting the position coordinate of the observation unit supporting section 5 in the Y-axis direction. An X-scale 14 is provided on the observation unit supporting section 5 for detecting the position coordinate of the observation unit 6 in the X-axis direction.

IN THE CLAIMS:

Cancel claims 1-20, without prejudice, and substitute therefor new claims 21-27, as follows:

21. (New) An apparatus for inspecting a substrate, comprising:

a substrate holder for holding a substrate to be inspected;

an observation unit supporting section comprising a

5 horizontal member that extends across the substrate holder and support columns that support the horizontal member at end portions thereof, said observation unit supporting section being movable along side edges of the substrate holder; and

10 a micro observation unit that is movable in a direction in which the observation unit supporting section extends, and that scans a surface of the substrate.

22. (New) An apparatus for inspecting a substrate according to claim 21, wherein said substrate is a glass substrate, and said substrate holder comprises a hollow frame for sucking and holding a peripheral portion of the substrate holder.

23. (New) An apparatus for inspecting a substrate according to claim 21, wherein said micro observation unit comprises a visual inspection microscope including an objective lens and an ocular lens.

24. (New) An apparatus for inspecting a substrate according to claim 21, wherein said micro observation unit comprises an image display device including a TV camera for imaging an object using an objective lens and a TV monitor for displaying an image.

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25. (New) An apparatus for inspecting a substrate according to claim 21, wherein said observation unit supporting section is integrally provided with a transmission linear light source which is arranged at a level lower than that of the substrate holder and which extends in a direction in which the micro observation unit moves.

26. (New) An apparatus for inspecting a substrate according to claim 21, further comprising:

guide scales provided for the substrate holder and extending along adjacent sides of the substrate; and

a position coordinate detection section, movable along the guide scale, that detects a defect position coordinate based on two indices that intersect each other at a defect position on the surface of the substrate.

27. (New) An apparatus for inspecting a substrate according to claim 26, wherein each of said indices is a linear illumination index.

REMARKS

Consideration of this application, as amended, is respectfully requested.

A new Abstract has been provided.

The specification has been amended in the same manner as in allowed parent Application Serial No. 09/158,362, of which the present application is a Divisional. Approval and entry of the amendments to the Abstract and specification is respectfully requested.

Claim 1-20 have been canceled, new claims 21-27 being substituted therefor. New claims 21-27 are clearly fully supported by the original disclosure. New claims 21-27 correspond respectively to canceled claims 28-34 of parent Application Serial No. 09/158,362.

It is respectfully requested that the amendments to the claims be approved and entered.

INFORMATION DISCLOSURE STATEMENT

Submitted herewith is a Form PTO/SB/08A listing the particulars of the documents cited by the Applicant and by the Examiner in parent application Serial No. 09/158,362, and which were made "of record" in said parent application.

Copies of the publications listed on the attached Form PTO/SB/08A are not supplied herewith. As per 37 CFR 1.98(d), which was effective March 16, 1992, copies of publications listed

in an Information Disclosure Statement are not required to be provided if the information was cited or submitted in a prior application. The present application properly identifies prior parent application Serial No. 09/158,362 (filed: September 22, 1998) and relies upon said prior parent application for an earlier filing date under 35 USC 120.

It is respectfully requested that the Examiner consider the publications identified on the attached Form PTO/S/08A submitted herewith and make them of record, as in the parent application.

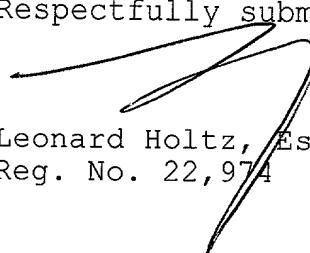
It is further requested that the Examiner return an initialed copy of the attached Form PTO/SB//08A to confirm that the publications listed therein have been made of record.

The references are all relevant since they are "of record" in the parent application which is directed to similar subject matter.

It is respectfully requested that prosecution on the merits now proceed on the basis of the application as amended herewith.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,

  
Leonard Holtz, Esq.  
Reg. No. 22,974

Dated: October 25, 2001

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ABSTRACT OF THE DISCLOSURE

An apparatus for inspecting a substrate includes a substrate holding member for holding a substrate to be inspected, a driving mechanism for raising the substrate holding member to a predetermined angle or less, a position coordinate detecting section provided at side edge of the substrate in at least two directions for detecting coordinates of a defect present in the substrate, an observation system supporting section provided for supporting a micro observation system and moving on the surface of the substrate, and a controlling section for controlling of the movement of the micro observation system of the observation system supporting section to correspond to a defect present in the substrate, on the basis of the position coordinates of the defect detected by the position coordinate detecting section.

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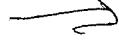
VERSION WITH MARKINGS TO SHOW  
CHANGES MADE

- 1 -

ACCURATE TRANSLATION

TITLE OF THE INVENTION

APPARATUS FOR INSPECTING A SUBSTRATE



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This is a <sup>BACKGROUND OF THE INVENTION</sup> division of Application Serial No. 09/158,362 filed September 22, 1998. The present invention relates to an apparatus for inspecting defects in a substrate such as a glass substrate for a liquid crystal display (LCD).

Of conventionally-known apparatuses for inspecting defects of LCD glass substrates, some apparatuses are 10 known in which defects (e.g., scratch) formed in the surface of the glass substrate can be checked by using a macro observation and a micro observation interchangeably. In the macro observation, light is applied onto the surface of the glass substrate and 15 then optical change of the reflected light is observed, thereby detecting the defects. In the micro observation, the defects found by the macro observation are magnified and observed.

For example, Jpn. Pat. Appln. KOKAI No. 5-322783 20 employs the macro observation system and the micro observation system which are set so as to correspond to an X-Y stage designed movable horizontally in X and Y directions. In the apparatus, the macro observation or the micro observation is performed by mounting 25 a substrate on the X-Y stage and bringing a portion of the substrate to be inspected (defect) into an observation <sup>field</sup> of the macro observation system or the micro observation system by moving the X-Y stage

two-dimensionally in the X and Y directions.

Recently, the size of the glass substrate <sup>is tended to</sup> ~~tends to~~  
✓ be increased with an enlargement of LCD<sup>5</sup>) In the case  
where such a large glass substrate is inspected by  
5 using the inspecting apparatus having the X-Y stage  
which is movable horizontally and two-dimensionally  
✓ <sup>as also</sup> (X, Y directions), four times as large as the area of  
the glass substrate is required as a space for moving  
the X-Y stage. Therefore, the substrate inspecting  
10 apparatus <sup>is</sup> ~~is~~ <sup>also</sup> <sup>become</sup> ~~become~~ <sup>in size</sup> ~~in size~~ inevitable large with the increase of the  
glass substrate.

Furthermore, in the conventional inspection  
✓ apparatus <sup>is</sup> ~~is~~ thus constructed, it is difficult to inspect  
a small scratch since the surface of the substrate  
15 is far away from an eye position of the inspector.  
Moreover, it is difficult to obtain positional data  
of the defect found in the surface of the substrate.  
Accordingly, it has been impossible to inspect the  
substrate highly accurately.

20 BRIEF SUMMARY OF THE INVENTION

An object of the present invention is to provide  
an substrate inspecting apparatus capable of detecting  
a defect of the substrate efficiently with high  
accuracy as well as to provide the apparatus in a  
25 reduced size.

The substrate inspecting apparatus of the present  
invention comprises substrate holding member for

that is, moving amounts of the reflectors 215, 216 in the X-axis direction and Y-axis direction from their origins can be detected by respective detectors (not shown) of the guide scales 19, 20, as coordinates (X, Y) of the defect. The detected results are output from the detector to the controller 11. Note that the origin of the coordinate of the reflector 215 is present at the forefront side of the guide scale 19. The origin of the coordinate of the reflector 216 is present at the rightmost end of the guide scale 20 (see FIG. 3).

FIG. 6 shows how to inspect a substrate by use of the inspecting apparatus of the present invention. As shown in FIG. 6, an entire-area illuminating macro light source 30 is set above the main apparatus 1. The macro light source 30 irradiates the entire area of the surface of the substrate 3 on the holder 2. The macro light source 30 is constituted of a <sup>composed</sup> metal halide lamp 31 serving as a point light source, a reflecting mirror 32 arranged so as to face the metal halide lamp 31, and a fresnel lens 33 arranged below the reflecting mirror 32. The reflecting mirror 32 is tilted at an angle of 45° with the main apparatus 1 and plays a role in reflecting light incident from the metal halide lamp 31 and injected into the fresnel lens 33. The fresnel lens 33 converges the light reflected by the reflecting mirror 32, as shown in the figure, and injects the

converged light over the entire surface of the substrate 3 on the holder 2. Note that, as shown in FIG. 1, the main apparatus 1 has a Y-scale 13 for detecting the position coordinate of the observation unit supporting section 5 in the Y-axis direction.

5 An X-scale 14 is provided on the observation unit supporting section 5 for detecting the position coordinate of the observation unit 6 in the X-axis direction.

10 The controller 11 shown in FIG. 1 is responsible for not only position coordinates (X, Y) of the defect detected by the guide scales 19, 20 and position coordinates of the observation unit supporting section 5 and the observation unit 6 detected by the Y-scale 13 and the X-scale 14, but also movement control of the observation unit supporting section 5 and the observation unit 6 by a driving mechanism (not shown). Furthermore, the controller 11 has a memory (not shown) for storing data of the interval  $x_0$  between an optical axis of the reference light source 8 and an optical axis of the objective lens 91. The control 11 controls movements of the observation unit supporting section 5 and the observation unit 6 so as to permit the optical observation axis of the objective lens 91 of the micro observation unit 9 to correspond with the position coordinates (X, Y) of the defect in the substrate 3 given by the guide scales 19, 20.

ABSTRACT OF THE DISCLOSURE

[The] apparatus for inspecting a substrate [of the]  
[present invention comprises] <sup>includes a</sup> substrate holding member  
for holding a substrate to be inspected, a driving  
5 mechanism for raising the substrate holding member to  
a predetermined angle or less, a position coordinate  
detecting section provided at side edge of the  
substrate in at least two directions, [for detecting  
coordinates of a defect present in the substrate,  
10 an observation system supporting section provided for  
supporting a micro observation system and moving on the  
surface of the substrate, and a controlling section for  
controlling of the movement of the micro observation  
system of the observation system supporting section to  
15 correspond to a defect present in the substrate, on  
the basis of the position coordinates of the defect  
detected by the position coordinate detecting section.